(51) International Patent Classification⁷: H04Q 11/04

(21) International Application Number: PCT/EP01/04131

(22) International Filing Date: 10 April 2001 (10.04.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0009226.2   12 April 2000 (12.04.2000)   GB

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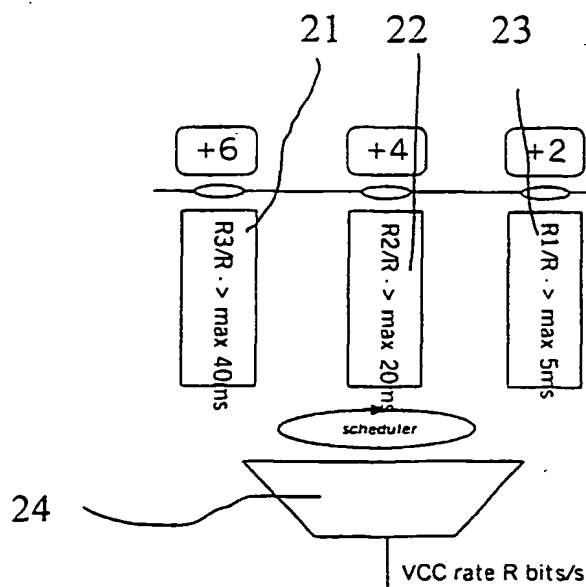(74) Agents: RUUSKANEN, Juha-Pekka et al.; Page White & Farrer, 54 Doughty Street, London WC1N 2LS (GB).

(81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— with international search report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: TRANSPORTING INFORMATION IN A COMMUNICATION SYSTEM

(57) Abstract: The present invention relates to transportation of information between nodes of a communication system. Information is transmitted by first transport entities from a first node to a second node and by second transport entities from the second node. Allowed transportation delays are defined for the first transport entities, and the first transport entities are distributed into transportation classes based on the allowed transportation delays. An indicator is assigned for a transport entity that is to be transported from the first node based on the transportation class thereof and also on information of a transport entity that is to be transported from the second node at a given moment of time. After the transport has been received at the second node information contained therein is inserted into a second transport entity, the selection thereof being based on the indicator.

Transporting information in a communication system

Field of the Invention

5   The present invention relates to transport of data in a packet switched communication system.

Background of the Invention

10   A communication system may provide the user, or more precisely, user equipment or terminal, with a circuit switched and/or a packet switched service. From these services the packet switched services can be defined in general as services that are capable of transporting information in data packets
15   or similar data units between two signalling points, such as between two terminals or between a terminal and a node in the network or between two network nodes.

A communications system typically operates in accordance with
20   a standard or specification which sets out what the various elements of the network are permitted to do and how that should be achieved. For example, the standard or specification may define whether the user, or more precisely, user equipment or terminal is provided with circuit switched and/or packet
25   switched service. The standard or specification may also define the various communication protocols and/or parameters which shall be used for the connection. In other words, the standards and/or specifications define the "rules" on which the communication can be based on. The various functions that
30   are based on these rules may be arranged in predefined layers, e.g. to so called protocol stacks.

A packet switched data network may be a communication network
that is based on use of a fixed line communication media. The
packet switched data network may also use a wireless
connection for at least a portion of a connection between the
5   two signalling points. ATM/AAL2 (Asynchronous Transfer
Mode/ATM Adaptation Layer type 2) and IP (Internet Protocol)
based data networks and various Local Area Networks (LAN) are
mentioned herein as examples of the packet switched networks.
Examples of communication networks that are capable of
10   providing wireless packet switched services, such as IP
(Internet Protocol) or ATM/AAL2 based packet data
transmissions, include, without limiting to these, the GSM
(Global System for Mobile communications) based GPRS (General
Packet Radio Service) network, EDGE (enhanced data rate for
15   GSM evolution) Mobile Data Network and third generation
telecommunication systems such as the CDMA (code division
multiple access) or TDMA (time division multiple access) based
3rd generation telecommunication systems that are sometimes
referred to as Universal Mobile Telecommunication System
20   (UMTS), and IMT 2000 (International Mobile Telecommunication
System 2000). All these relate to the transfer of data to and
from mobile stations or similar user equipment providing the
user thereof with a wireless interface for the data
transmission.
25

In a typical wireless communication system a base station (BS)
serves user equipment via a wireless interface. For example,
in the WCDMA radio access network the user equipment is served
by Node B, which is connected to and controlled by an element
30   called as a radio network controller (RNC) node over e.g. an
Iub interface. The RNC element may be connected to and
controlled by a mobile switching center (MSC), a serving GPRS
support node (SGSN) or similar controller facility in the core

network side of the communication system. The interface
between the access network and the core network is often
referred to as an Iu interface. Several connections or calls
may be established simultaneously over the interface between
5   the core and access networks. The core network may transmit
various information that associate with the connection over
the interface. The information may include quality of service
(QoS) information defining, among other possible parameters,
characteristics of the radio link, e.g. the allowed delay in
10   the transmission of information frames in the system. The term
radio link refers to the part of the connection or "call" that
is transported over the radio interface. In the access network
the same part of the call is transported over the Iub and Iur
interfaces by a frame protocol (FP) connection. The
15   characteristics of the radio link are typically defined by the
access network controller based on information that associates
with the call and that has been received from one or more of
the controllers of the core network. The information may
include, for example, quality of service parameters.
20

In the proposed data communication systems, such as the UMTS,
data streams may transported via various communication
channels that may be referred to as transport channels.
Examples of the transport channels, without limiting to these,
25   include a dedicated channel (DHC), a downlink shared channel
(DSCH) and a common packet channel (CPCH). A specific frame
protocol (FP) may be used in the UMTS for conveying the
transport channels between the base station and the radio
network controller and also between two or several network
30   controllers. The frame protocol frames are to be inserted into
the radio frames to be transmitted over the radio link. The
exemplifying frame protocols have been specified in more

detail e.g. in 3GPP (3rd Generation Partnership Project)
specifications TS25.427, TS25.425 and TS 25.435.

Packet switched systems may use timing parameters to define a
5   window within which the data packets belonging to a data
stream should have been received. To keep the synchronisation
of a data stream the controller node may include an
appropriate connection identifier to the frames that are to be
transmitted to the user equipment. An example of the
10   identifier is a Connection Frame Number (CFN) that may be
added to a DCH FP frame or to the DSCH TFI Signalling control
frame. A frame protocol frame is typically provided with a
header, the header including a field for the connection frame
number. In the downlink direction (i.e. in direction from the
15   RNC node to the base station) the RNC node inserts to the
field a frame number in which it wants the base station to
transmit the frame in the radio interface. In the radio link
the radio frames are sent sequentially (e.g. in an order
defined by frame Nos., such as … 56, 57, 58, 59, …). The
20   subsequent frames may be transmitted, for example, with 10ms
intervals, in which case a frame number equals 10ms in the
time axis. The RNC controller node of the radio access network
is aware of the frame number that is to be transmitted at the
radio link (interface) of the base station at a given moment.
25

If a FP frame of a data stream arrives too late or too early
(i.e. outside a receiving window) to the base station and thus
cannot be inserted into a radio frame defined e.g. by the CFN,
the base station deletes the frame and sends a notification of
30   this to the controller so that the controller may advance or
delay the transmission of the subsequent FP frames
accordingly. An example of the adjustment procedure is
discussed in mode detail in the above refereed 3GPP (3rd

Generation Partnership Project) TS 25.427 Specification titled
'Group Radio Access Network; UTRAN Iub/Iur Interface User
Plane Protocol for DCH Data Streams (version 3.1.0 Release
1999)'.

5

At current no mechanism has been proposed how to prioritise
different simultaneous frame protocol connections. However,
the inventor has found that the handling order of the data
streams and/or data content thereof, i.e. traffic handling
10   priority, could be useful in various occasions in order to
differentiate various connections from each other. The traffic
handling priority may be defined as a feature that specifies
the relative importance for handling of service data units
(SDUs) belonging e.g. to a UMTS radio access bearer (RAB)
15   compared to the SDUs of other bearers. The service data units
(SDUs) may comprise a data packet or any other data
transmission entity that may be seen as forming an information
unit.

20   The inventor has also found that the currently proposed
transport network layer may not be used in the most efficient
manner in all occasions. For example, the available
transmission capacity of the interface may not be used in an
efficient/optimised manner when more than one frame protocol
25   connection occur at the same time. Since no differentiation is
available, all services (e.g. radio bearers conveying the
services) typically need to be transmitted with a similar
quality of service (QoS) parameters. That is, with the similar
transfer delay requirement the QoS would be determined by the
30   most stringent service, even though not all services may
require this. As a result the needed amount of bandwidth in
the packet switched media may be significantly bigger than
what might be required if some kind of service differentiation

could be used. The inventor has found that the service
differentiation may allow the system to benefit from
statistical multiplexing that is available in the packet
switched transport systems. In addition, timing information
5   that is based on parameters received from the core network
side may not always provide an appropriate base for the timing
to be used by the nodes of the radio access network.

Summary of the Invention

10

It is an aim of the embodiments of the present invention to
address one or several of the above problems.

According to one aspect of the present invention, there is
15   provided a method for transporting information in a packet
switched communication system comprising a plurality of nodes,
wherein information is transmitted by first transport entities
from the first node to the second node and by second transport
entities further from the second node, the method comprising:
20   defining allowed transportation delays for the first transport
entities; distributing, in the first node, the first transport
entities into a plurality of transportation classes based on
information of the allowed transportation delays; assigning an
indicator for a transport entity to be transported from the
25   first node to the second node based on information of the
transportation class thereof and information of a transport
entity of said second transport entities that is to be
transported from the second node at a given moment of time;
transporting said transport entity from the first node to the
30   second node; and receiving the transport entity at the second
node and inserting information in said received transport
entity into a transport entity of the second transport
entities based on the indicator.

According to another aspect of the present invention there is
provided a communication system, comprising: a first node and
a second node, wherein information is transmitted by first
5   transport entities from the first node to the second node and
by second transport entities further from the second node;
means for defining allowed transportation delays for the first
transport entities; in the first node, means for distributing
the first transport entities into a plurality of
10   transportation classes based on information of the allowed
transportation delays; means for assigning an indicator for a
transport entity to be transported from the first node to the
second node based on information of the transportation class
thereof and information of a transport entity of said second
15   transport entities that is to be transported from the second
node at a given moment of time; interface between the first
and second nodes for transporting said transport entity from
the first node to the second node; and means for inserting
information in the transport entity received at the second
20   node into a transport entity of the second transport entities
based on the indicator.

The embodiments of the invention may improve the transport
efficiency of the transport network layer, for example such
25   that the efficiency in using of the available transmission
capacity of the interface is improved. By means of use of the
differentiation all services may not need to be transmitted
with a similar service characteristics, but different service
parameters may be assigned to different services. The
30   embodiments may enable differentiation of various bearers from
each other. For example, the embodiments enable an arrangement
in which the most stringent service does not define the
quality of service parameters for all radio bearers with a

similar transfer delay requirement. The prioritisation between different service classes may enable more efficient use of the transport resources, since the statistical multiplexing gain may be increased. As a result the needed amount of bandwidth

5   in the packet switched media may be less than in the case where no service differentiation is used. This may be the case especially in interfaces within a radio access network. In addition, the embodiment may enable adjustment of timing parameters so as to match better to the internal conditions of

10   a subnetwork of the communication system.

Brief Description of Drawings

For better understanding of the present invention, reference

15   will now be made by way of example to the accompanying drawings in which:
        Figure 1 shows a communication system in which the embodiments of the present invention may be implemented;
        Figure 2 is a schematic illustration of queues in a

20   access network node;
        Figure 3 illustrates an example of transport entities; and
        Figure 4 is a flowchart illustrating the operation of one embodiment of the present invention.

25

Description of Preferred Embodiments of the Invention

Reference is first made to Figure 1 which shows a communication system that provides resources for packet

30   switched communication and in which the embodiments of the present invention may be employed. Figure 1 system is capable of providing wireless packet switched services for a user 1 thereof by means of a public land mobile networks (PLMN) 2. A

user 4 is provided with fixed line packet switched services by
means of a data network 3. It should be appreciated that while
the embodiments of the invention are described in the context
of a UMTS (Universal Mobile Telecommunications System) and
5   more specifically, with reference to ATM/AAL2 based UTRAN
(UMTS terrestrial access network), the embodiments of the
present invention are applicable to any other packet switched
communication system which deals with packet data.

10   Some of the elements of a UMTS PLMN system 2 will be discussed
briefly in the following with reference to Figure 1. A mobile
station or other appropriate user equipment 1 is arranged to
communicate via the air interface with a transceiver element 6
of the PLMN system. It should be appreciated that the term
15   mobile stations is indented to cover any suitable type of
wireless user equipment, such as portable data processing
devices or web browsers and various types of mobile
telephones. The area covered by the PLMN system 2 may be
divided into a plurality access entities (not shown),
20   typically referred to as cells. Each access entity has
associated therewith a transceiver element 6, typically
referred to as base station or node B. The term base station
will be used in this document to encompass all elements which
transmit to and/or receive from wireless stations or the like
25   via the air interface.

The base station is controlled by a radio network controller
node (RNC) 7 over an Iub interface there between. The radio
network controller 7 and the base station are a part of an
30   access network 8 such as the UMTS Terrestrial Radio Access
Network UTRAN. The controller 7 may also communicate with a
second controller 17 of the access network over an Iur
interface. The Iur interface may divide the access network

into two or several radio network subsystems (RNS), each
subsystem typically including one radio network controller
RNC. Use of ATM/AAL2 in the UTRAN is given as an example of
the possible protocol, although other protocols, such as the

5   IP protocol, may be used in the UTRAN 8. The use of ATM/AAL2
in the UTRAN environment means that a type 2 ATM adaptation
layer is on top of the ATM layer in a manner that is similar
e.g. to arrangements where a UDP (user datagram protocol)
layer is on top of an IP layer.

10

It should be appreciated that a UMTS network is typically
provided with more than one access network, that an access
network may comprise any appropriate number of controllers and
that each radio network controller is arranged generally to

15   control more than one base station 6. If more than one RNC is
provided, they all may communicate with each other over an Iur
interface provided there between. The distribution of the
various elements of the UTRAN 8 is an implementation issue.

20   The radio access network 8 is connected to a core network of
the system over an appropriate interface. In the UMTS
specifications this interface is typically referred to as an
Iu interface. The connection over the Iu interface may be
provided between the RNC 7 and a SGSN (serving GPRS support

25   node) 14. Among other functions, the SGSN 14 keeps track of
the mobile station's location and performs security functions
and access control. The SGSN 14 is shown to be connected to a
GGSN (gateway GPRS support node) 16. The GGSN 16 provides
interworking with the other packet switched network 3. In

30   other words, the GGSN 16 acts as a gateway between the UMTS
network 2 and the other data network 3, such as an IP based
data network.

Another user terminal 4 is shown to be connected to the data network 3. The exemplifying arrangement is such that the terminals 1 and 4 may communicate via the packet switched networks 2 and 3. However, it should be appreciated that

5 embodiments of the invention may be applied to other types of packet switched communication arrangements as well, such as to an arrangement where the user 1 (or 4) communicates with an element that is implemented within the network 2 (or 3) or to an arrangement where two elements of the network 2 (or 3)

10 communicate internally within the network.

Although not shown, the network system 2 may also be connected to conventional telecommunication networks, such as to a GSM based cellular public land mobile network (PLMN) or to a

15 public switched telephone network (PSTN). The various networks may be interconnected to each other via appropriate interfaces and/or gateways.

A transport channel such as a dedicated (transport) channel

20 (DCH) may be established between the radio access network 8. and the user equipment 1. In order to keep the synchronisation of the data stream of the dedicated channel DCH the RNC 7 includes a Connection Frame Number CFN to all DCH FP frames that are transmitted in the downlink, i.e. from the RNC 7

25 towards the user equipment 1. The used frame protocol may provide, among other functions, support for a transport channel synchronisation mechanism and/or support for a node synchronisation mechanism. The timing parameters of the frame protocol may be used to define a window within which the data

30 packets belonging to a data stream should have been received. The CFN can be defined as a frame indicator that contains information of the radio frame in which the data in the FP frame shall be transmitted further from the base station on

the downlink. If a downlink data frame arrives outside a
determined arrival window to the base station, the base
station 6 may report a measured time of arrival ToA and the
indicated CFN e.g. in a so called uplink UL DCH FP control

5   frame. This possible timing adjustment procedure is described
in more detail in the above referenced 3GPP TS25.427
specification. The following will outline the main features of
this possible adjustment window arrangement.

10 The measured time of arrival ToA can be defined as the time
difference between an end point of a downlink arrival window
(this may be referred to as Time of Arrival Window Endpoint:
ToAWE) and the actual arrival time of the downlink frame for a
specific CFN. A positive ToA means that the FP frame is

15 received before the ToAWE. A negative ToA means that the FP
frame is received after the ToAWE. The ToAWE typically
represents the time point by which the downlink data should
have arrived to the base station from the Iub interface
between the RNC 7 and the base station 6. The ToAWE may be

20 defined as the amount of milliseconds before the last time
point from which a timely downlink transmission for the
identified CFN would still be possible. The internal delays of
the base station or any other predefined parameters may be
taken into account in here. The ToAWE may be set via a control

25 plane. If the data does not arrive before the endpoint set
forth by the ToAWE, a Timing Adjustment Control Frame TACF may
be sent by the base station 6 to the RNC 7. A Time of Arrival
Window Startpoint (ToAWS) parameter represents the time after
which the downlink data shall arrive to the base station 6

30 from the Iub. The ToAWS is typically defined as the amount of
milliseconds from the ToAWE. The ToAWS may also be set via the
control plane. If the data arrives before the point defined by

13

the ToAWS, a Timing Adjustment Control Frame may be sent by
the base station to the RNC 7 (cf. the ToAWE).

Referring now also to Figure 2, the following describes a
5   mechanism for quality of service (QoS) differentiation in the
packet switched transport system that may be used for example
in the UMTS Terrestrial Radio Access Network (UTRAN) or a
GPRS/EDGE Radio Access Network (GERAN). The embodiments may
gain benefit in the transport efficiency by taking into
10   account possible individual requirements of the different
radio bearers that are setup in the system. The prioritisation
into different service classes in accordance with the maximum
delay of the call may increase the efficiency since the
statistical multiplexing gain increases, and thus the
15   bandwidth (transmission bitrate) requirement at the Iub
interface may decrease. In addition, by means of the
differentiation it may be possible to take into account the
less strict delay requirements of non-realtime (NRT) data
transportation.
20

However, the prioritisation may not be enough alone since the
frame protocol layer is delay sensitive (e.g. due to the frame
indicator set by the RNC and the size of the delay window that
is set when establishing the radio link). In the embodiments
25   described below this is addressed by taking the different
delays of the transport layer into account for each call by
introducing so called frame indicator offset. By means of the
indicator offset it may be possible to decrease the amount of
notifications by the base station (or other node) regarding FP
30   frames that have arrived too late or too early.

The differentiation mechanism may involve both the transport
layer and the radio network layer of the protocol stack, as

there is interaction between the Frame Protocol (FP)
procedures at the Radio Network layer and the transport
performance at the transport layer (for the interaction, see
the timing adjustment procedures described above). The service

5   is not differentiated at the frame protocol layer but rather
in the transport layer by selection of an appropriate
transportation queue for the frame protocol connection. This
means that although the frame protocol layer may be used in
the mechanism, it does not need to be used for other purposes

10 than for signalling the frame indicator to another node in the
radio access network. The frame protocol layer may be only
indirectly involved since the indicator (CFN) and/or the
offset thereof is defined based on the selected
differentiation class.

15

In the exemplifying embodiments a protocol (transport layer
user) is on the radio network layer that is delay sensitive
and the user operations may be dependent on the underlying
transport layer delay performance. The offset of the FP frame

20 indicator is preferably chosen in accordance with an expected
maximum delay. The maximum delay may be determined by
selecting the transport layer queue/scheduling discipline
(e.g., service category). The transport layer service category
may be selected based on various service characteristics, such

25 as tolerated delay, the size of the frame payload, service
data unit (SDU) size, amount of information to be transported
in a data bearer, amount of payload in a FP frame, error
tolerance, urgency of the data, importance of the data and so
on.

30

Figure 2 illustrates a possibility for differentiating the
various frames into various transport service classes of a
transport layer of the protocol stack. It should be

appreciated that the embodiment is described in the context of the radio network controller 7 of Figure 1, although the same scheme may be applied in other nodes of the packet switched communication system as well. The distribution of the frames

5   is based on the allowed maximum delay of the data connection. Information concerning the allowed maximum delay may be obtained from the core network, e.g. as quality of service (QoS) information.

10   Before explaining the queues of Figure 2 in more detail, a brief reference is made to Figure 3 illustrating the general structure of a possible transport entity. The exemplifying DCH FP frame consists of a header portion and a payload portion. The header may contain various information that is required

15   for controlling the transportation of the frame, such as a CRC checksum, the frame type field (control frame, data frame) and information related to the frame type. The payload portion of FP data frames may contain various information to be transported between nodes. The payload of control frames

20   contains commands and measurement reports related to transport bearer and the radio interface physical channel but not directly related to specific radio interface user data.

Returning now to Figure 2, in the illustrated example three

25   transport queues 21 to 23 are used for differentiating the FP frames from each other. The queue 21 is for data bearers that allow maximum delay of 40ms, the queue 22 is for bearers that allow maximum delay of 20ms and the queue 23 is for bearers that allow a maximum delay of 5ms. A scheduler 24 is for the

30   selecting frames from the queues based on a predefined scheme to be transported to the base station.

The service differentiation may be implemented by means of the transport layer. In order to make the radio network layer work properly on top of the transport layer it is necessary to couple these two layers together in an appropriate manner.

5   This may be accomplished as follows. The Frame Protocol (FP) layer instance is made aware of the expected transport delay of the FP frames thereof. By means of this the FP layer may set the Connection Frame Number (CFN) of the FP frames that are about to depart the RNC queues accordingly. The CFN in the

10 FP frame before or after the payload (i.e. in the header or in the trailer of the frame) indicates in the receiving peer the radio frame in which the payload of the given FP frame is to be sent over the radio interface towards the user equipment 1. The queuing may cause a delay depending on the selected queue

15 and/or weight set for the queue.

If the transport layer queuing delay is not taken into account when setting the CFN, the FP frames may arrive too late in the base station 6. This may result in the above described

20 procedure for Timing Adjustment between the peer FP instances and may cause loss of data and/or unnecessary reservation of bandwidth. This delay may be addressed by an off-set that is assigned for the CFN indicator. The following describes a practical example how this may be accomplished.

25

Lets assume that the transport layer defines a service class that ensures 20ms transport delay over the Iub interface. The off-set of the delay may be measured in radio frames (the example assumes a radio frame that has a length of 10ms). In

30 this case the frame indicator offset i.e. CFN-offset of the corresponding FP connection is set such that this delay is taken into account. This may be accomplished e.g. such that the RNC 7 assigns to all FP frames that are departing from the

RNC 7 and that associate with the connection a frame indicator
CFN in accordance with the scheme CFN = CFN(i)+3, wherein
CFN(i) indicates the radio frame that is to be transmitted at
the same time over the radio link between the base station 6
5   and the user equipment 1. Now, since the maximum delay is
20ms, and the frame indicator is set so that the
transportation of the radio frame is to be offset 3*10ms. By
means of this the FP frame should have arrived by the time the
assigned radio frame is to be transported from the base
10   station.

In addition to offsetting the delay, it is possible to adjust
the size of the receiving window of the base station during
the radio link set-up such that the base station will not
15   react too "sensitively" to frames that arrive too early. A
frame may arrive too early e.g. since data in a selected queue
can in some instances be transported faster than expected,
whereby the transport between the nodes occurs faster than
e.g. in the above mentioned 20 ms (the queuing is typically a
20   statistic process with a certain distribution for the expected
queuing time). The set 20ms maximum delay means that the
probability for exceeding the 20 ms is relatively small.
However, in some instances this may mean that the probability
for a too early arrival in the base station increases.
25

Figure 4 shows a flowchart that illustrates further the
principles of the above described procedure. During the
connection set-up the corresponding transport layer service
class is determined. The determination may be based, for
30   example, on the Radio Access Bearer parameters or the
determined Radio Bearer parameters. This depends on the
implementation of the RNC node. Thereafter either one of the
existing transport layer queues (service or connection

specific) may be selected or a new queue may be created or the
weight of an existing queue may be modified. Connection
Admission Control (CAC) may also be performed at this stage in
order to check and reserve the resources that are required by
5   the new transport connection. After this the connection set-up
signalling towards the peer node, e.g. the base station or
another RNC, can be started. The set-up signalling is used for
sending information of the transport service class. To give an
example, but without limiting to these, this information can
10   be conveyed in messages such as 'NBAP *Radio Link Setup Request*
[transport channel information]', 'Q.aal2 *Establish Request*
[AAL2 path characteristics] or [Served User Transport]',
depending on the application. In the above the NBAP is an
abbreviation of node B application protocol and SUT is an
15   abbreviation of Served User Transport. Q.aal2 refers to AAL2
Signalling protocol that has been specified in ITU-T
(International Telecommunication Union) Recommendation Q.2630.
Q.aal2 is the transport network signalling protocol that may
be used in the UTRAN Release 99 for the signalling between the
20   access network nodes.

The Served User Transport (SUT) parameter of Q.aal2 can be
used for this purpose as it has been specified to convey
information transparently between the two peer served users. A
25   possibility would be to map the transport service class to the
AAL2 Path Characteristics parameter that has been introduced
in Q.aal2 CS-2 (capability set 2). However, this specific
mechanism may be applicable only in the non-switched scenario
of using AAL2 signalling and other application may require
30   different implementations. In this approach the number of
service classes may be by default two(stringent or tolerant).
It is emphasised that the AAL2 Path Characteristics have been
originally specified by ITU-T (International Telecommunication

Union) for AAL2 Path selection (i.e., ATM VCC; asynchronous transfer mode virtual channel connection) rather than for the selection of AAL2 CPS queue.

5   Coupling may be needed between the transport layer queue selection and the Radio network layer scheduling also if so called Layer 1 multiplexing is applied in the radio interface between the base station 6 and the user equipment 1. Layer 1 multiplexing refers to a technique where more than one

10   transport channel becomes mapped to the same radio frame in the radio interface. These frames need to be available in the base station at the same time even though the frames may be transported via separate transport channels on Iub and/or Iur interfaces.

15

A queue that associates with a service class may represent a given ATM connection (e.g. ATM VCC) to which the AAL2 connections of said class (i.e. connections that are transported through the same queue) are multiplexed. The queue

20   may also represent a certain part of AAL2 connections that are transported through an ATM VCC. In other words, in the latter scenario all classes share the same ATM VCC but the different AAL2 connections have different priorities.

25   The new FP instance may be initialised according to the delay performance of the selected transport service class. The delay performance of the transport service class is determined by the queue service discipline and the serving rate. The rate may be defined e.g. by weight if a weighting scheme such as

30   Weighted Fair Queuing is used. The weighting function may be implemented such that the weights of the queues are configurable by the user of the network element (e.g. the operator of the network 2 or the user of the mobile station

1). Dynamic adjustment of the weights of the queues may also
be enabled, e.g. in accordance with the amount of data in the
queues. The weights of the queues may be assigned and/or the
dynamic changing of the weights is preferably implemented
5   during the activation/deactivation of the data bearers i.e.
the logical connections between the core network and the user
equipment.

The above described mechanism is needed in order to be able to
10   benefit from the service differentiation along a path from the
originating node to the destination node (e.g. in a path over
the Iub between the RNC 7 and the base station 6). The
differentiation may be based e.g. on the chosen delay or the
quality of service QoS parameter or class. The signalling of
15   the selected transport service class to the peer node (BS) can
be performed in several ways. For example, Node B Application
Protocol (NBAP) or a RNSAP in case of an Iur interface between
two radio access network nodes can be used. The use of already
existing protocols may require addition of an appropriate
20   transport priority information element into the corresponding
protocol message (e.g. Radio Link Addition).

It is noted that the above disclosed solution is applicable
also in any IP (Internet Protocol) based transport
25   environment. The above described queuing scheme may be
implemented by, for example, IP Differentiated Service
architecture, where each queue is then mapped into a certain
Per-Hop-Behaviour (PHB) feature of an IP DiffServ application.
In general, the embodiments may be implemented independently
30   of the type of the used transport protocol.

It should be appreciated that whilst embodiments of the
present invention have been described in relation to FP frames

and radio frames, embodiments of the present invention are
applicable to any other suitable type of transport entities
between two or more nodes. In addition, although the
embodiments relate to wireless user equipment, embodiments of
5   the present invention are applicable to any other suitable
type of user equipment. The embodiments of the invention have
discussed the interface between the radio network controller
and the base station of the radio access network. Embodiments
of the present invention can be applicable to other network
10   elements where applicable. The communication may be in the
uplink direction, in the downlink direction or within the
access network or any other network entity comprising at least
two nodes.

15   It is also noted herein that while the above describes
exemplifying embodiments of the invention, there are several
variations and modifications which may be made to the
disclosed solution without departing from the scope of the
present invention as defined in the appended claims.

Claims

1.   A method for transporting information in a packet
switched communication system comprising a plurality of nodes,
5   wherein information is transmitted by first transport entities
from the first node to the second node and by second transport
entities further from the second node, the method comprising:
    defining allowed transportation delays for the first
transport entities;
10   distributing, in the first node, the first transport
entities into a plurality of transportation classes based on
information of the allowed transportation delays;
    assigning an indicator for a transport entity to be
transported from the first node to the second node based on
15   information of the transportation class thereof and
information of a transport entity of said second transport
entities that is to be transported from the second node at a
given moment of time;
    transporting said transport entity from the first node to
20   the second node; and
    receiving the transport entity at the second node and
inserting information in said received transport entity into a
transport entity of the second transport entities based on the
indicator.
25

2.   A method as claimed in claim 1, wherein the information
in the indicator associates with an offset required for
compensating the allowed delay of said transport entity at the
second node.
30

3.   A method as claimed in claim 1 or 2, wherein the first
transport entities comprise frames of a frame protocol layer.

4.   A method as claimed in any preceding claim, wherein the second transport entities comprise radio frames.

5.   A method as claimed in any of claims 2 to 4, wherein the offset is expressed as a number of radio frames.

6.   A method as claimed in any preceding claim, wherein the first transport entities are distributed into transportation queues in the first node, each queue being assigned for a transportation class based on a priority criteria.

7.   A method as claimed in any preceding claim, wherein the first node is made aware of the transport entity that is to be transported further from the second node at the same time as a transport entity is to be transported from the first node to the second node.

8.   A method as claimed in any preceding claim, wherein the first node generates the indicator to be assigned for said transport entity.

9.   A method as claimed in any preceding claim, wherein the indicator includes a parameter for use in compensation of the allowed delay of said transport entity.

10.   A method as claimed in any preceding claim, wherein the transport entities are distributed into said plurality of transportation classes in a transport layer.

11.   A method as claimed in claim 10, wherein the indicator is transported in a frame protocol layer.

12.   A method as claimed in any preceding claim, wherein the
indicator comprises an order number, the transport entities
being transported sequentially from the second node in an
order that is defined by said order number.

13.   A method as claimed in claim 12, wherein the first node
generates the order number based on information of the order
number of the transport entity to be transported from the
second node.

14.   A method as claimed in claim 12 or 13, wherein the first
node generates the order number based on information of the
transportation interval between the transport of two
subsequent transport entities from the second node.

15.   A method as claimed in any preceding claim, comprising
setting a timing window for the arrival of the transport
entity in the second node, said timing window defining a
period within which the transport entity is acceptably
received at the second node.

16.   A method as claimed in preceding claim, wherein the
information entities to be transported from the first node
comprise a payload portion, and wherein the indicator is
inserted into the transport entity either before or after the
payload portion.

17.   A method as claimed in any preceding claim, wherein the
distribution of the transport entities into the transportation
classes is also based on at least one of the following: amount
of information to be transported by frames of a data bearer;
amount of data packets contained in a frame; error tolerance;

size of frame payload; urgency of the information; importance
of the information.

18. A method as claimed in any preceding claim, wherein the
first and second nodes are comprised in a radio access
network.

19. A method as claimed in claim 18, wherein the first node
comprises a radio network controller and the second node
comprises a base station.

20. A method as claimed in claim 19, wherein the base station
transports the transport entities further to a user equipment
via a wireless link at a moment of time that is defined based
on the indicator.

21. A method as claimed in claim 20, wherein the radio
network controller controls the establishment of the wireless
link between the radio access networks and the user equipment,
the distribution to different transportation classes being
accomplished in a transport layer of the protocol layer stack
of the radio access network.

22. A method as claimed in claim 18, wherein the first node
comprises a base station and the second node comprises a radio
network controller.

23. A method as claimed in claim 18, wherein the first and
second nodes each comprise a radio network controller.

24. A method as claimed in any preceding claim, wherein at
least one transportation of the transport entities is based on
the Internet Protocol.

25. A method as claimed in any of the preceding claims, wherein the information entities are distributed in the first node into a plurality of transportation queues based on

5   quality of service parameters.

26. A method as claimed in any preceding claim, comprising multiplexing more than one transport channel into a transport entity.

10

27. A method as claimed in any preceding claim, comprising the step of setting weights to at least one of the transportation classes.

15   28. A communication system, comprising
          a first node and a second node, wherein information is transmitted by first transport entities from the first node to the second node and by second transport entities further from the second node;

20   means for defining allowed transportation delays for the first transport entities;
          in the first node, means for distributing the first transport entities into a plurality of transportation classes based on information of the allowed transportation delays;

25   means for assigning an indicator for a transport entity to be transported from the first node to the second node based on information of the transportation class thereof and information of a transport entity of said second transport entities that is to be transported from the second node at a

30   given moment of time;
          interface between the first and second nodes for transporting said transport entity from the first node to the second node; and

means for inserting information in the transport entity
received at the second node into a transport entity of the
second transport entities based on the indicator.

5   29.   A communication system as claimed in claim 28, wherein
the information included in the indicator associates with an
offset that is required for compensating allowed delay of said
transport entity at the second node.

10   30.   A communication system as claimed in claim 29, wherein
the offset information comprises a parameter that is based on
radio frames.

31.   A communication system as claimed in any of claims 29 to
15   30, wherein the first node is adapted to generate the
indicator to be assigned for said transport entity.

32.   A communication system as claimed in any of claims 29 to
31, wherein the first transport entities comprise frames of a
20   frame protocol layer and the second transport entities
comprise radio frames.

33.   A communication system as claimed in any of claims 29 to
32, wherein transportation queues that are assigned each for a
25   transportation class are provided by the first node, the first
node being adapted to distribute the first transport entities
into in the queues.

34.   A communication system as claimed in any of claims 29 to
30   33, wherein the first node is provided with information
concerning the transport entity that is to be transported
further from the second node at the same time as a transport

entity is to be transported from the first node to the second node.

35. A communication system as claimed in any of claims 29 to
34, wherein the indicator comprises an order number, the arrangement being such that transport entities are transported sequentially from the second node in an order that is defined by said order number.

36. A communication system as claimed in any of claims 29 to
35, comprising means for setting a timing window for the arrival of the transport entity in the second node, said timing window being adapted to define a period within which the transport entity is acceptably received at the second node.

37. A communication system as claimed in any of claims 29 to
36, wherein the first and second nodes are comprised in a radio access network.

38. A communication system as claimed in any of claims, wherein the first node is adapted to distribute the transport entities into the plurality of transportation classes based on quality of service parameters.
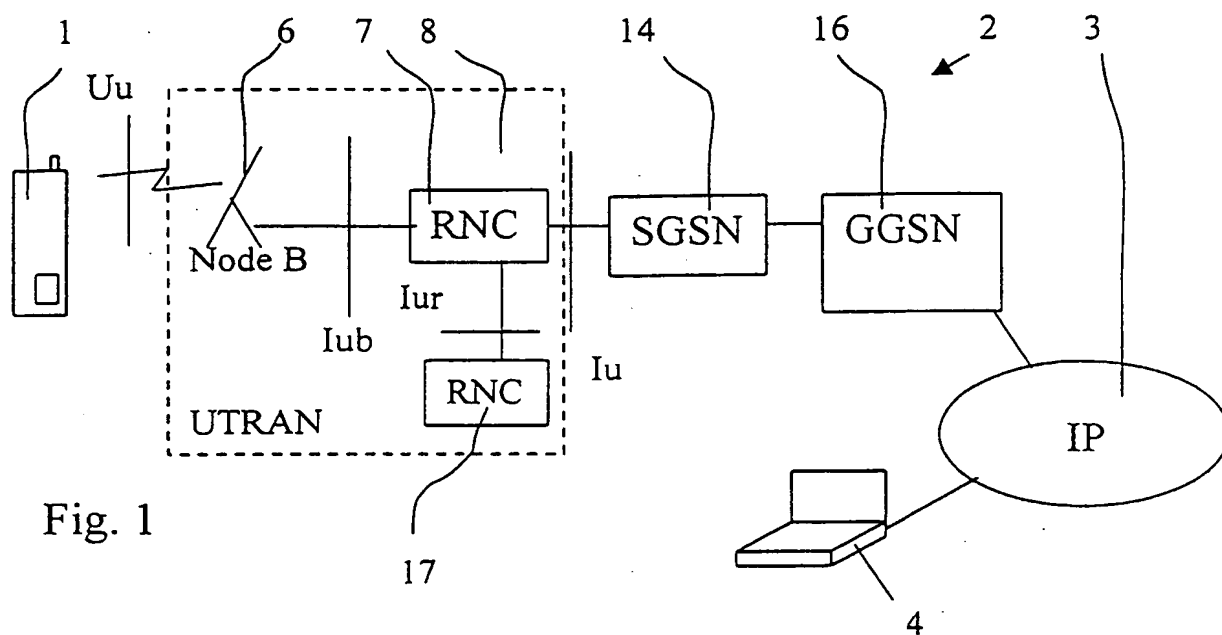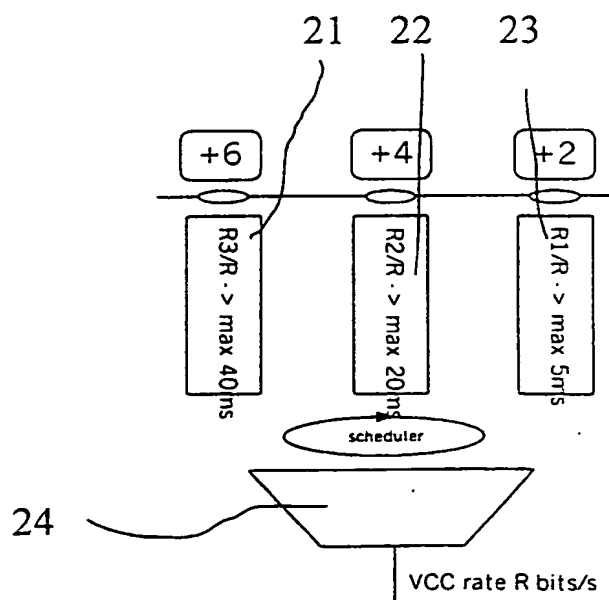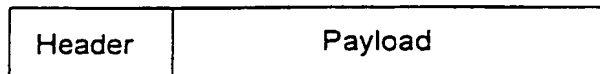
Fig. 1

Fig. 2

Fig. 3

Header	Payload

Fig. 4

Radio bearer set-up:
Select the transport service class

Start connection set-up
Select queue / set queue weight

Perform CAC (to check that the VCC rate is
sufficient)

Initialise a FP instance: set CFN offset in a FP
frame according to the expected transport delay

Transport the FP frame to the BS

Insert the payload of the FP frame into a radio
frame based on the CFN offset

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7   H04Q11/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7   H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	WO 99 44390 A (DIXIT SUDHIR S ;SUBBIAH BARANITHARAN (US)) 2 September 1999 (1999-09-02) page 3, line 28 -page 4, line 23 page 5, line 25 -page 6, line 20 page 8, line 1 - line 3 ─── -/--	1,3,6-8, 10,17, 28,38 2,5,9, 24,29

[X] Further documents are listed in the continuation of box C.   [X] Patent family members are listed in annex.

° Special categories of cited documents :

'A' document defining the general state of the art which is not considered to be of particular relevance

'E' earlier document but published on or after the international filing date

'L' document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

'O' document referring to an oral disclosure, use, exhibition or other means

'P' document published prior to the international filing date but later than the priority date claimed

'T' later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

'X' document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

'Y' document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

'&' document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 June 2001	27/06/2001

Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Authorized officer Gregori, S

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
X	ENEROTH G ET AL: "APPLYING ATM/AAL2 AS A SWITCHING TECHNOLOGY IN THIRD-GENERATION MOBILE ACCESS NETWORKS" IEEE COMMUNICATIONS MAGAZINE,US,IEEE SERVICE CENTER. PISCATAWAY, N.J, vol. 37, no. 6, June 1999 (1999-06), pages 112-122, XP000835287 ISSN: 0163-6804 page 114, column 1, line 1 -page 115, column 1, line 32; figures 5,6 page 118, column 2, line 14 -page 119, column 2, line 26; figure 10 ---	1,4,18, 19,23
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